AGRICULTURAL Research

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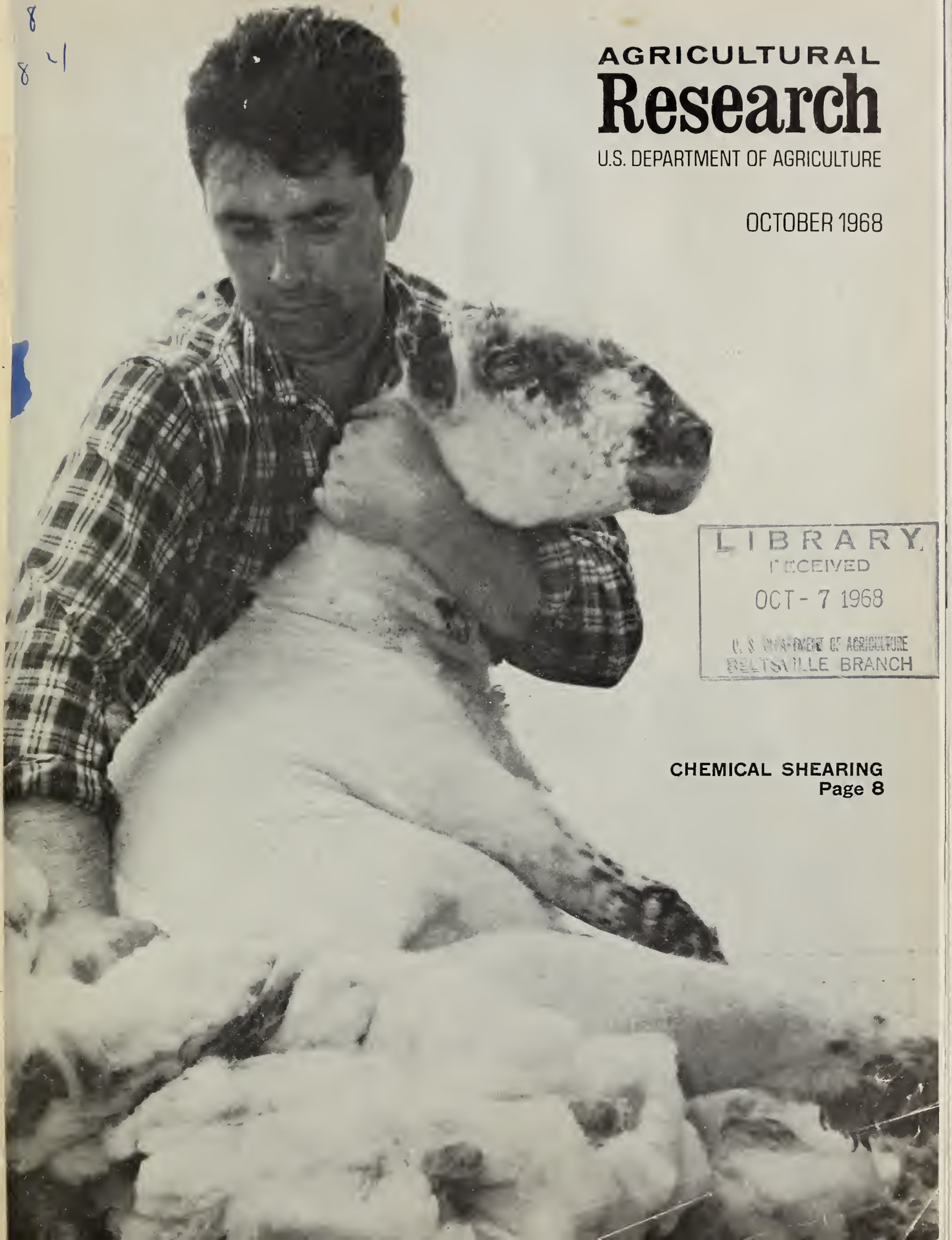

CHEMICAL SHEARING
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The Green Revolution

After years of bleak headlines on the world's food problems, there are signs that much of southern Asia is on the verge of an agricultural revolution that may prove as significant as the Industrial Revolution of the 18th century.

Record harvests underlie this emerging optimism. The dramatic yields of new varieties of grain have spurred many farmers to adopt new varieties and farm practices faster than had been planned or anticipated. If family planning campaigns make comparable progress, the outlook will be bright indeed.

For agricultural research has made it *technologically* possible to banish hunger. Experts say that if the developing nations embraced improved grains, fertilizers, and pesticides they could quadruple their food supplies. But to fully realize research benefits, such basic problems as land tenure, credit, education, and transportation must be overcome faster and on a greater scale than ever before. Meanwhile, we must speed modern farm practices to every village.

There is, unfortunately, a wrong and deeply ingrained notion that our highly successful farm practices can be exported intact. What developing countries need are scientifically trained hunger fighters—men who can apply their know-how to new problems, untried soils, different climates, and who can teach farmers who till the soil with forked sticks and bullocks.

For almost a century, USDA has provided technical assistance to other nations. In this tradition, 52 ARS scientists went to Asia the past fiscal year to help increase food production and to devise ways to process, store, and distribute harvests. During this same period, 273 Asian students came here to learn how to grow more food for their homelands. Moreover, 365 Public Law 480 projects are today solving Asian agricultural problems while training young researchers who some day will help their people help themselves.

ARS scientists join their colleagues in other Government agencies, foundations, universities, and business in furthering the Green Revolution. It may be the most crucial revolution of our time.

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Orville L. Freeman, Secretary
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Agricultural Research Service

Inspectors using Dickens' method are taught to recognize visible A. flavus *mold on peanuts. Closer examination, when necessary, is done under a microscope with 25X magnification (PN–1690).*

NEW TECHNIQUES SPEED PEANUT INSPECTION

RESEARCH HAS PROVIDED the peanut industry with two new and faster methods for detecting mold and mold damage in peanuts.

Inspectors can use the new methods for quick tentative identifications, reserving as a final test the present time-consuming laboratory system.

The peanut quality-control process includes checking peanuts for the presence of *Aspergillus flavus* mold. The mold sometimes produces a toxic byproduct called aflatoxin, which under controlled experimental conditions is known to have carcinogenic effects in animals. Aflatoxin detection is the subject of an intense and continuous cooperative program conducted by the Federal-State Peanut Inspection Service, USDA, and other Government agencies to safeguard consumers against the possibility of any potential danger of aflatoxin getting into food or feed channels.

At marketing points, Federal-State inspectors grade the peanuts, which are then placed into one of three segregation bins for storage. Segregation One bins contain peanuts with less than 2 percent damaged kernels, not more than 1 percent concealed damage caused by rancidity, mold or decay, and which are free from visible *Aspergillus flavus*. Peanuts in Segregation Two bins contain a greater amount of damage but no visible *A. flavus* mold. Segregation Three peanuts contain visible *A. flavus* mold.

Segregation One peanuts must pass laboratory tests before they can be sold for human consumption. Meal made from Segregation Two and Three peanuts can be used only in animal feed, provided it passes laboratory tests; oil extracted from these peanuts is always free of aflatoxin.

Tons of good peanuts in storage bins, however, could be contaminated by the presence of smaller amounts of peanuts containing aflatoxin. Removing the contaminated kernels is expensive, but if all contaminated peanuts are not removed, sizeable losses result.

The standard detection test—conducted only after peanuts have been removed from bins and shelled—involves analyzing the peanut samples by thin-layer chromatography (TLC). This consists of several critical and lengthy steps and takes from 2 to 6 hours. Highly skilled personnel are needed to operate the expensive equipment and to properly identify the presence and quantity of aflatoxin.

The two new tests were developed to overcome these disadvantages by enabling inspectors to detect suspect kernels rapidly *before* the peanuts are put into bins. The tests were used by the Federal-State Inspection Service during this peanut marketing season.

The visual examination method, developed by ARS agricultural engineer J. W. Dickens and ARS plant pathologist R. E. Welty at Raleigh, N.C., offers a simple, rapid means of tentatively identifying the *A. flavus* mold.

Workers without previous training or experience can be taught the process quickly, usually in an hour of instruction followed by 2 to 3 hours of intermittent close supervision. Instruction consists of showing peanut kernels with visible *A. flavus* mold and teaching recognition of the mold by its particular characteristics. Closer examination, when necessary, is done under a microscope with 25X magnification. On the average, a sample can be inspected in about a minute.

As a check on these tests, laboratory analyses verified that the *A. flavus* mold was correctly differentiated from other molds by visual examination 87 percent of the time. The laboratory tests also revealed that not all of the peanuts with *A. flavus* mold were aflatoxin contaminated.

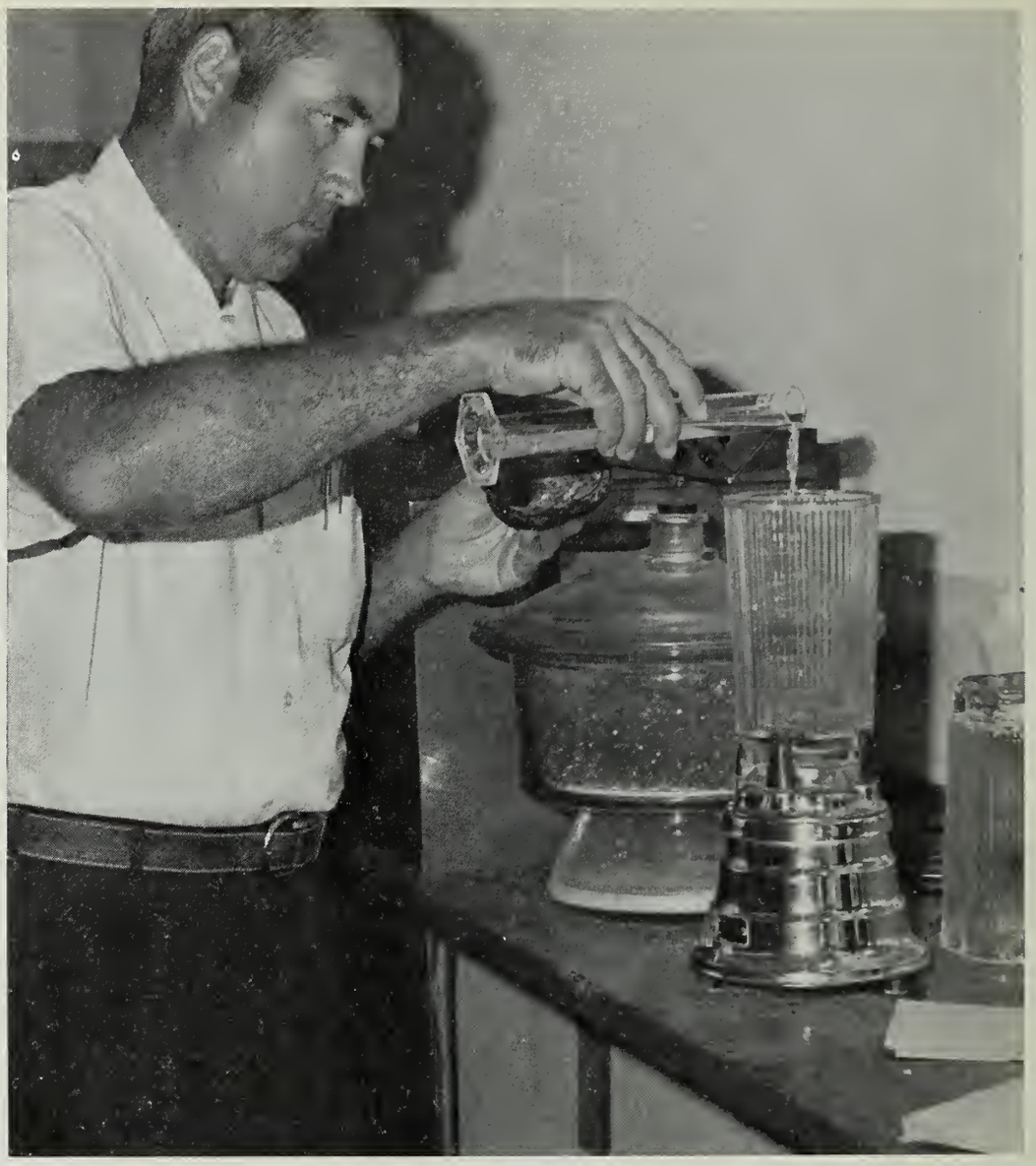
The advantage of diverting badly contaminated peanuts to Segregation Three storage outweighs the disadvantage of possibly diverting quantities of questionable peanuts that do not have aflatoxin.

The other detection method tested this year was developed by ARS biochemist C. E. Holaday at Albany, Ga. His method is similar to the laboratory TLC process but performed on a much smaller scale. It is faster, simpler, and cheaper than TLC and requires little training or laboratory equipment. Samples can be screened for the presence of aflatoxin in about 15 minutes at the marketing site.

In Holaday's process, extracts of peanuts in millicolumns (small glass tubes 4½ cm. long) are placed under ultraviolet light while being warmed for 5 minutes at 60° C. If aflatoxin is present, a blue fluorescent band appears. The approximate amount of aflatoxin is determined by comparing the millicolumn with another containing a known, laboratory-verified quantity. More precise quantitative verifications can be made later by the standard TLC process.

The only equipment needed is a blender for making extractions, a source of heat and ultraviolet light, and the millicolumns which can be prepared beforehand in a laboratory at a rate of some 450 a day.

As ARS continues its search for better methods of detecting aflatoxin, ways to prevent mold development through improvement of growing, harvesting, and handing techniques are also being sought.■



In Holaday's method, peanuts are placed in a blender with a solvent and an extract is made. Millicolumns are placed in the extract which then enters these glass tubes by capillary action (ST–4038–3).

Next step is to warm millicolumn under ultraviolet light. If aflatoxin is present, a blue fluorescent band appears (ST–4038–9).

The top flask and spatula held by Rackis contain material which behaves like bananas in a spray drier; the sticky mass adheres to the walls, making drying difficult and expensive. When soy protein is added as in the lower flask, the material becomes a light-colored, easily handled dry powder (PN–1691).

Promising high-protein food for infants

BANANA BEVERAGE POWDER

SOY PROTEIN AND BANANAS have been teamed by Israeli scientists into a new protein-enriched powder for beverages.

The two complement each other unusually well; the soy protein permits the sticky banana puree to be dehydrated and the banana is an attractive carrier for the protein. The powder can contain from 4 to 20 percent soy protein.

The research was conducted under a Public Law 480 grant awarded by ARS. Purpose of this work was to develop an improved process for the large-scale extraction of high-grade protein from soybeans and to adapt the resulting protein materials to promising foods for protein deficient regions.

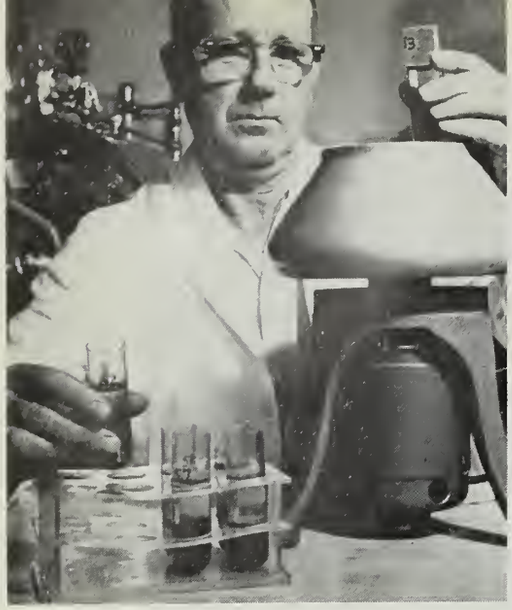
The scientists designed a system for commercial use that increases soy protein yield while reducing the extraction time. In searching for a way to adapt the protein to foods, they found that bananas could play the carrier role for soy protein without sacrificing flavor, color, or nutritive value.

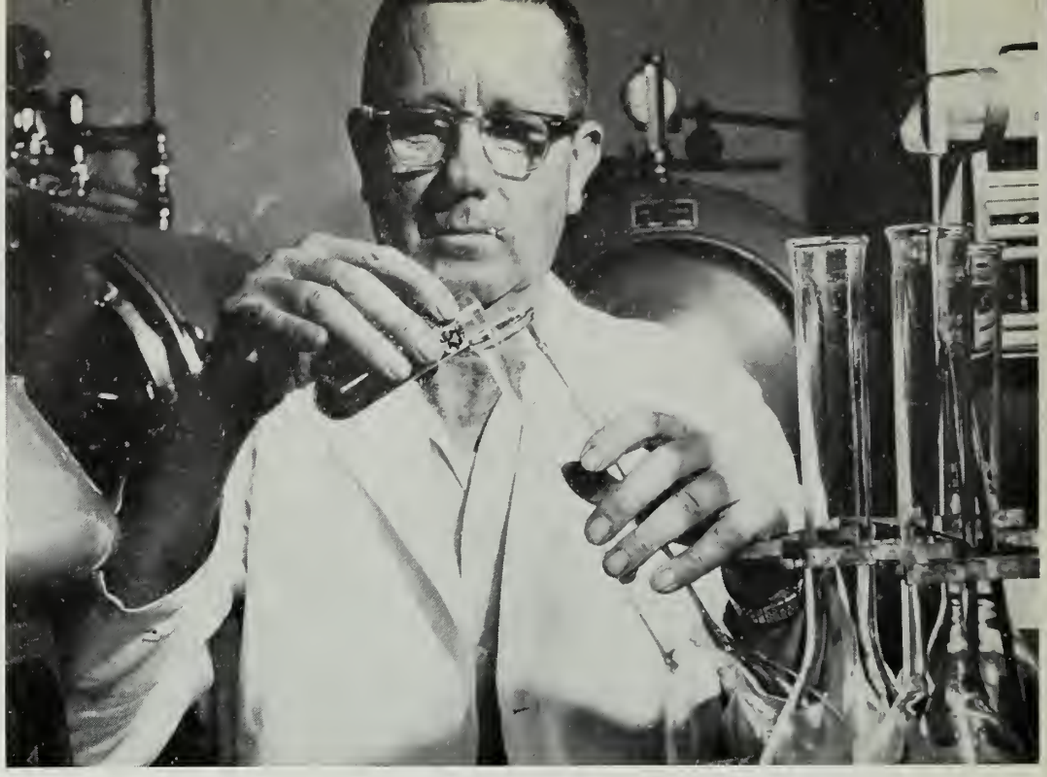
But bananas belong to a group of foods—mostly fruits—that form a sticky mass and cannot be spray-dried in the usual way. The most economical method to prepare pureed fruit for spray-drying is to add a material that increases the percentage of nonsticky solids. This is usually done by adding milk powder: the Israeli scientists found that soy protein also makes the conversion to powder possible.

The resulting banana-soy powder makes a beverage that has potential for weanling and infant feeding, particularly where milk is unavailable or insufficient.

ARS chemist J. J. Rackis, sponsoring scientist at the Northern utilization research laboratory, Peoria, Ill., says the soy protein may also prove acceptable in preparing cheeses, with or without the incorporation of butterfat, milk, or whey. In other food tests, Israeli scientists increased the protein level of certain bread formulas about one-half by replacing 6 percent of the flour with soy protein.

This project was conducted at the Technion Research and Development Foundation, Haifa.■





DeMar places samples in centrifuge; at right, first fraction is removed (BN–32697, BN–32695).

AUTOCLAVING: *a quicker soil test*

AUTOCLAVING OF SOILS—a chemical process to separate forms of nitrogen with heated water under pressure—may prove to be a quick method for determining nitrogen availability.

Nitrogen in the soil can be in many chemical forms, not all of which plants can use. ARS scientists are looking for ways to determine that portion in a particular soil which, through natural processes, will become available to plants.

Autoclaving requires much less time than the week or two needed in standard incubation methods and could lead to better use of fertilizer by providing more accurate estimates of nitrogen needs.

ARS soil scientists George Stanford and technician W. H. DeMar at Beltsville, Md., autoclaved several soils in a dilute hot water solution of calcium chloride for 16 hours and then determined the amounts of nitrogen present in four fractions of the extract.

The first fraction, removed from the extract through the addition of sodium hydroxide, correlated highly with each soil's capacity to convert nitrogen into plant-available form through soil micro-organisms. This capacity had been determined in previous studies.

The other three fractions of the extract, as well as the total nitrogen extracted, showed a poor correlation with the amount of plant-available nitrogen.

Stanford and DeMar autoclaved a wide range of agricultural soils. Before autoclaving, they leached test soils with a salt solution to remove the plant-available nitrogen. If not removed, this nitrogen, left from previous fertilization or the natural conversion of nitrogen into usable materials for plants, might give false notions as to the true nitrogen supplying abilities of the soils.

In the tests, soil samples were placed in stainless steel centrifuge tubes along with a calcium chloride solution and heated for 16 hours at 121° C. The pressure was set at 15 pounds per square inch. The extract was concentrated through centrifuging and then washed to recover all traces of the solution.

Extraction was done with dilute calcium chloride solution to minimize dispersion of the soil and to stabilize pH (soil acidity or alkalinity). A unique feature of this extraction procedure is that pH control is not required. Soils of various pH readings can be treated alike. In most other extraction procedures, pH is controlled at some definite level for all extractions.

In addition, moisture content of soils does not affect test results. Methods involving incubation are affected by soil moisture content or the way the soils are dried.■

Gates for Automatic Irrigation

SHORTAGE OF FARM labor and rising costs are spearheading research to bring automated irrigation to the fields of this country.

ARS researchers are not only making surface irrigation equipment less dependent upon manpower but also getting more mileage out of each cubic foot of water. Projects underway on mechanical and on hydraulically controlled irrigation gates are part of this research.

ARS agricultural engineer A. S. Humpherys, Snake River Conservation Research Center, Kimberly, Idaho, has developed three mechanically controlled gates which operate with energy supplied by the irrigation water. These gates, especially suited to border and basin methods of irrigation, are fully automated and require little attention. They are generally used in pairs, diverting water for a predetermined time onto one portion of a field after another.

One of the three types, called center-of-pressure gates, opens when the water level on the upstream side rises above a certain height. A counterbalance closes the gate when the water level is lowered.

Sinking-float border gates, another type, have floats mounted on the bottom front. When water comes down the ditch, the floats rise, opening the gate. The float chamber has an opening in the bottom and a controlled air escape on top. Escaping air controls the rate at which the float sinks. Irrigation is cut off when the float submerges and closes the gate.

The third mechanical gate, similar to the center-of-pressure type, is the float-operated check gate. This type of gate is latched and has a concrete counterweight at the top. The float is rigged to unhook the latch, allowing the gate to open. The counterweight is shifted to the upstream side when the gate opens. When the water recedes, the weight shifts to the downstream side, hooking the latch, thereby making the gate ready for the next irrigation.

The other side of the irrigation picture, hydraulically controlled gates, is under study by ARS soil scientist H. R. Haise and agricultural engineer E. G. Kruse, Fort Collins, Colo., and ARS agricultural engineer L. J. Erie, Phoenix, Ariz.

The researchers used the hydraulic gates to automate the irrigation of five 2-acre sets (fields) of citrus at Yuma, Ariz. Commercial production of the gates is now being considered.

In this system, gates are opened and closed by water-operated hydraulic cylinders activated by sinking-float assemblies in the field.

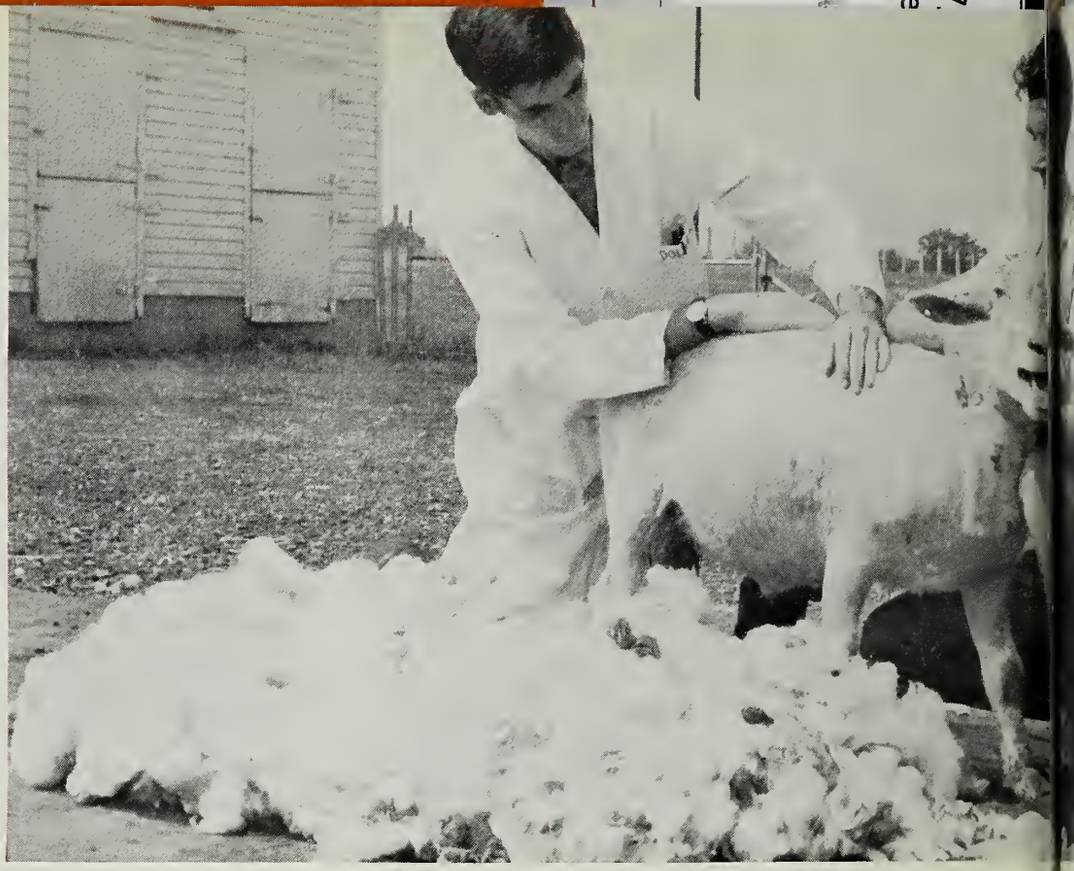
Irrigation water is turned onto the first set. When water reaches a sinking-float sump toward the far end of this field, action of the sinking-float assembly opens gates to the next set. A similar assembly at the upper end of the next set turns off the water in the first. Water then reaches a sump in the far end of the second set, opening gates for the third, and the cycle continues.

A high-pressure water line (60 to 70 pounds per square inch) is used to power the three-way and four-way valves on the assembly as well as the hydraulic cylinders.

In the Yuma study, ARS scientists used a water wheel unit to power the system, with an auxiliary gas engine as a standby.

The Idaho and Colorado Agricultural Experiment Stations cooperated in this research.■

Concrete counterweight on float-operated check gate shifts to upstream side when gate opens, to downstream side when water recedes, hooking latch and making gate ready for next irrigation (PN–1692).



SHEARING SHEEP *with chemicals*

NO NICKS
NO CUTS
NO SKILLS

NOTHING LOOKS QUITE as naked as a chemically defleeced sheep, but this rarity may become common if preliminary tests pan out.

The chemicals being tested interrupt cell growth in the bulb of each wool fiber, causing a ringlike constriction. The constriction moves up from the bulb of each wool fiber as it grows and in 6 to 7 days, reaches a position just below the skin surface.

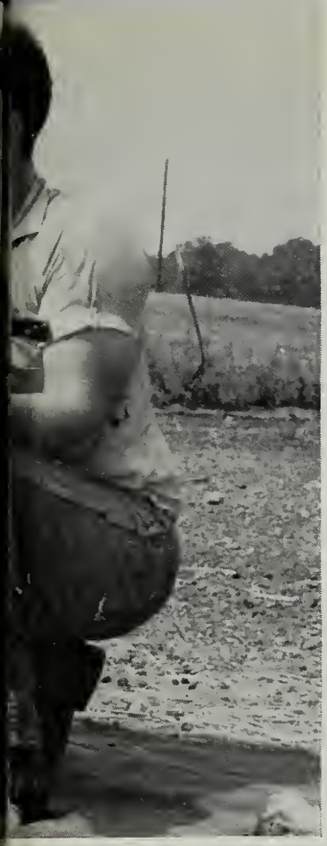
At that point, the fiber breaks easily and the whole fleece can be separated at the skinline, leaving the sheep completely bare. An operator grabbing a handful of wool and rolling his wrist along the skin can defleece a sheep quickly and systematically without strain on himself, discomfort to the sheep, or wastage of wool.

Ease of removal, in fact, is the main advantage of chemical defleecing. Shearing with clippers is a highly skilled task, calling for wages of about $12 per hour at Beltsville, Md., where the ARS trials are being conducted. By contrast, a nonspecialist drawing about $2.50 per hour can quickly learn to remove fleeces from sheep treated chemically.

In addition, defleecing, unlike shearing, does not leave nicks and cuts on the skin. Although sheep seemed unaffected by the complete lack of fleece, precautions were taken to keep sheep out of extreme weather after defleecing. Wool has grown back normally on sheep defleeced since the trials began. The most recent trial showed that defleecing can be delayed beyond the minimum of 6 or 7 days after chemical treatment so that a short growth of new wool forms below the constriction point of the wool fibers. The fleece separates as easily as before but the new coat does away with the possibility of having to protect the sheep from any extreme weather that may follow defleecing.

Compounds tested for defleecing by ARS biologist E. H. Dolnick and coworkers are new drugs used in anticancer studies. Medical scientists at the National Cancer Institute and Hazleton Laboratories found that these drugs, aimed at stopping cell growth in tumors, also interrupted cell growth in hair roots. This caused test subjects, including sheep, to lose their hair temporarily, a finding that renewed Dolnick's long-standing interest in putting chemical defleecing on a practical basis.

The process is not as unnatural as it sounds. American buffalo, for example, lose big clumps of long winter hair each spring; Angora rabbits are conventionally dehaired by plucking without chemicals; and most sheepmen know individual cases of partial fleece loss in sheep after severe illness, parasitism, or grazing on shrubs con-



Far left: *The first pull (ST–3967–4).* **Lower far left and cover:** *Technician Dale Harper removes wool easily by rolling his wrist along the skin (ST–3966–8, ST–4033–9).* **Center:** *A completely defleeced sheep. Bare, pink skin shows when wool is separated 6 or 7 days after treatment. Laboratory assistant T. M. Murphy is at left (ST–3966–14).* **Near left:** *Harper and Murphy illustrate that wool can be removed as one complete fleece (ST–3967–8).* **Below top:** *New growth on recently defleeced sheep (ST–3967–14).* **Below bottom:** *Delaying pulling until 14 or more days after treatment allows the constriction line to grow out farther. After pulling, a short growth of wool remains, covering the skin (ST–4034–25).*

taining chemicals which act like those being tested by Dolnick.

In the tests, a typical compound was given to sheep by mouth or injection in doses ranging from 2 milligrams (mg.) to 41 mg. per pound of body weight. The highest level was fatal; levels below 27 mg. caused no apparent harm, and even the lowest levels caused wool to loosen reasonably well. With the most effective dose, about 14 mg., undesirable side effects have not been detected.

Further studies are necessary to determine whether chemical defleecing is economically practical and whether it causes chemical residues in the meat or alters wool growth or quality. Drug choice, dosage, or time of treatment may need adjustment if such problems are uncovered. Still, Dolnick thinks defleecing may help relieve the labor shortage and price squeeze now plaguing the sheep industry.■

1000-year-old boll weevil

Mexican cave discovery

COTTON FRAGMENTS FROM a Mexican cave have added a thousand years to the history of the boll weevil and given scientists a promising lead to new sources of insect resistance in wild cotton plants.

The cotton had entombed a boll weevil that, for some unknown reason, had failed to chew its way out of a cotton boll. One of the oldest insects to pass through the ARS Systematic Entomology Laboratory, Washington, D.C., the boll weevil was identified by ARS entomologist R. E. Warner as a form intermediate between two species that ravage cotton in Mexico and the United States: *Anthonomus grandis grandis* and *A. g. thurberiae.*

Above: *The weevil (ST–3891–16).* **Below:** *Smith (left) and Warner examine the boll and weevil (ST–3891–14).*

To the untrained eye, the ancient weevil looks like its two cousins, and the entomologists cannot distinguish it from a form still living in western Mexico and southern Arizona.

ARS botanist C. E. Smith, Jr., obtained the cotton fragment from an archeological excavation in Oaxaca, Mexico, but credits discovery of the weevil to S. G. Stephens, professor of plant evolution at North Carolina State University. Stephens found the insect within an empty seed hull while examining cotton fragments that he borrowed for study from Smith.

Thanks to the dry climate and the untidy housekeeping habits of the Zapotec Indians who once inhabited the Oaxaca caves, the cotton fragments survived undamaged and untouched from about the year A.D. 900. Archeologist K. V. Flannery who sent the fragments to Smith, reports that the radioactive carbon 14 dating technique and the presence nearby of pottery from a known era in Indian civilization firmly dated the cotton.

Entomologists are certain from examination of the boll that the weevil is as old as the cotton fragments, and not a present-day weevil that found its way into the cotton seed.

Before discovery of this pre-Columbian weevil, scientists inferred from the lack of ancient history on the insect that its fondness for cotton was acquired in recent times. Although the boll weevil was first designated a distinct species in 1843 on the basis of a specimen from Veracruz, its plant hosts were not identified until 1880, when infestations hit Mexican cotton fields. Its history in the United States is even more recent: Boll weevils crossed the Rio Grande into Texas in 1892 and reached North Carolina by 1922.

The new discovery does not disprove the idea that the weevil originally subsisted on other plants, but it does show that the insect is not a newcomer to cotton.

Scientists hope to collect wild cotton in the Oaxaca area with the resistance that has enabled the plant to survive weevil attacks for the past millennium. This resistance might then be bred into commercial cotton crops.

Explorations among the Oaxaca caves have been conducted in cooperation with the Mexican Government and were supported by the National Science Foundation, University of Maryland, University of Michigan, and the Smithsonian Institution.■

A fly and a wasp... possible agents for COTTON PEST CONTROL

TWO INSECTS THAT parasitize cotton pests may prove effective biological controls, lowering cotton production costs and reducing insecticide requirements.

ARS scientists are now searching for practical ways to employ these parasites in the fields. At Tucson, Ariz., entomologists D. C. Bryan, C. G. Jackson, and Raymond Patana reared the tachinafly *Lespesia archippivora* and studied its parasitic effects on salt-marsh caterpillars, beet armyworms, cabbage loopers, and bollworms.

The tachinafly is small (one-eighth inch), gray, and very active. The female lays her microscopic eggs on the surface of the host. Within 20 minutes, the eggs hatch into tiny maggots that burrow into the host. As many as 17 parasitic maggots may emerge from one host.

The entomologists found the tachinafly prefers larvae of the salt-marsh caterpillar and beet armyworm; both pests were selected as possible hosts in a tachinid mass-rearing program.

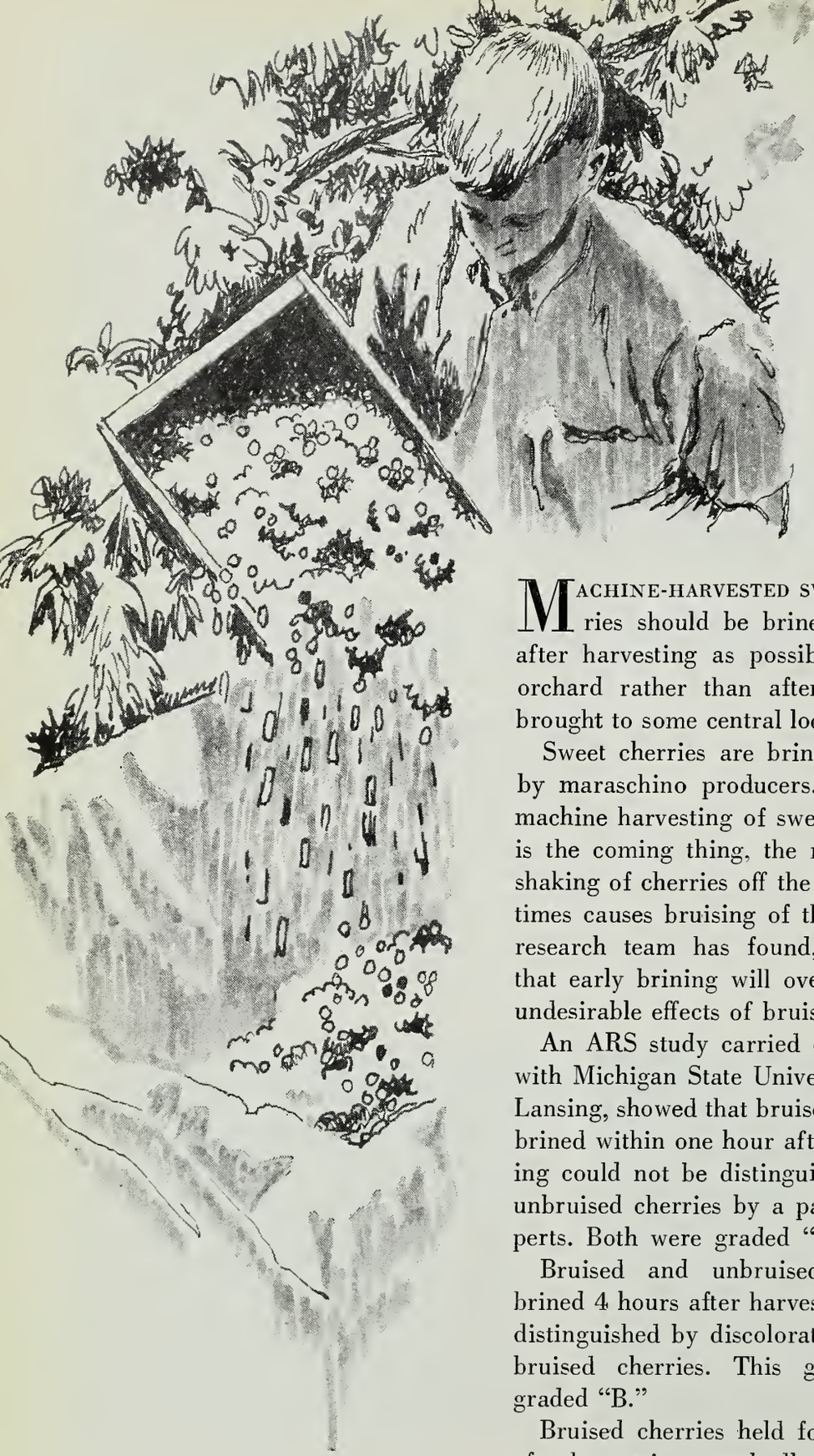
At College Station, Tex., entomologists R. L. Ridgway and J. R. Cate of the Texas Agricultural Experiment Station, tested the insecticide tolerance of the small wasp *Campoletis perdistinctus*. It parasitizes bollworms and budworms with no harm to people and beneficial living things.

Systemic insecticides control most major cotton insects, except the bollworm and budworm. But if use of systemic insecticides and releases of *C. perdistinctus* were coordinated, Ridgway and Cate think it probable that less insecticide would be needed.

In field tests, the scientists released wasps on caged plants previously treated with the usual amounts of two systemic insecticides—Temik and disulfoton. Virtually no wasps died when released 11 days after the plots were treated. Only 12 to 18 percent of the wasps died when released as early as 24 hours after treatment.

Temik has not been registered by USDA for use on cotton.■

Left: *A tachinafly lays eggs on tobacco budworm. Eggs hatch within 20 minutes (PN–1694).* **Above:** *Tachinafly maggots emerging from a bollworm (PN–1695).*



Sweet Cherries

Orchard brining overcomes harvest bruises

MACHINE-HARVESTED SWEET cherries should be brined as soon after harvesting as possible—in the orchard rather than after they are brought to some central location.

Sweet cherries are brined for use by maraschino producers. Although machine harvesting of sweet cherries is the coming thing, the mechanical shaking of cherries off the tree sometimes causes bruising of the fruit. A research team has found, however, that early brining will overcome the undesirable effects of bruising.

An ARS study carried out jointly with Michigan State University, East Lansing, showed that bruised cherries brined within one hour after harvesting could not be distinguished from unbruised cherries by a panel of experts. Both were graded "A."

Bruised and unbruised cherries brined 4 hours after harvest could be distinguished by discoloration of the bruised cherries. This group was graded "B."

Bruised cherries held for 8 hours after harvesting were badly discolored and of unacceptable quality.

The study was conducted by ARS chemist R. T. Whittenberger, ARS agricultural engineer J. H. Levin, and horticulturist H. P. Gaston of Michigan State University.

In the tests, the researchers deliberately bruised one group of handpicked cherries by dropping each cherry three times on a hard surface. Unbruised cherries were kept as controls.

A group of bruised and unbruised cherries were then brined immediately after harvest, another group was brined 4 hours later, and another group was brined 8 hours later. The cherries were kept in the brine for 3 months. The researchers then evaluated cherry quality and measured weight, size, firmness, and stem attachment strength.

As an incidental benefit, brining increased stem attachment strength, and brining immediately after harvest gave the maximum increase—as much as 75 percent over that of freshly picked cherries. A strong stem attachment is very desirable, especially for fancy cocktail cherries.

Brining also has the desirable effect of increasing the firmness of the cherries, but the time of brining (immediately to 8 hours after picking) made no significant difference in the fruit's firmness.

Although there is slightly more shrinkage in cherries brined immediately than in those brined later, the superior quality of the early-brined fruit much more than compensates for the small loss in quantity due to shrinkage.■

DBCP controls citrus nematode

THE CITRUS NEMATODE, a serious pest of irrigated citrus trees in the Southwest, can be controlled at an annual cost of 10 to 12 cents per tree.

Yield increases of 154 percent for grapefruit and 57 percent for oranges resulted from treating the roots of the trees with DBCP pesticide (1,2-dibromo-3-chloropropane plus other halogenated C_3 compounds).

Found the world over, the nematode *Tylenchulus semipenetrans* is a tiny worm that sticks its head into individual cells of small roots and devours their contents. Many roots are killed, thus depriving the trees of nutrients and causing dieback in the outermost branches—symptoms of the disease called slow decline.

In tests conducted at Phoenix, Ariz., ARS nematologist H. W. Reynolds mixed an emulsion containing 75 percent DBCP (by weight) into irrigation water at a rate of 2 to 6 gallons per acre. His only equipment was an inexpensive metering device to regulate the amount of emulsion going into the irrigation water. The emulsion can also be metered through a centrifugal pump.

The treatment resulted not only in more fruit, but in greater fruit size and more premium fruit. Over a 7-year period, treated grapefruit trees had an average annual increase of 510 percent in the amount of fruit size count 40 and a 242-percent increase in the amount of fruit size count 48 or larger. The size count (40 and 48) refers to the number of fruit required to fill a shipping carton.

In a 3-year test on navel oranges, fruit size had increased 22 percent by the third year.

The treatment should be made when the soil is in good tilth, as level as possible, and free of weeds. In groves that are not level, small dams can be built to help equalize distribution of the pesticide.

Even with his largest doses of DBCP, however, Reynolds did not completely eliminate the nematodes. A few always survived and built up the population again until another treatment became necessary in 2 to 5 years, depending on the rate of build-up and the size of the initial dose.

Considering the moderate cost, Reynolds feels that citrus growers in areas heavily infested with citrus nematodes can hardly afford not to treat their groves.■

Citrus nematodes pierce plant tissue, here a citrus root cell, and suck out the contents (PN–1693).

Warming Revives Stored Potatoes

An occasional warming up can revitalize potatoes stored at low temperatures.

Recommended storage temperature for table-stock potatoes is 38 to 40° F., which is high enough to avoid damage from chilling. In cold climates, however, this high a storage temperature is difficult to maintain.

ARS plant physiologists H. W. Hruschka and J. E. Baker and plant pathologist W. L. Smith, all stationed at Beltsville, Md., found that in such cases warming test potatoes for a brief period every few weeks prevented much of what they call the "chilling injury syndrome."

In tests over a 19-week period, potatoes were warmed to 60° F. for 1 week after every 3 weeks at 32° F. This warming significantly reduced external mold, decay, and browning as compared with holding potatoes continuously at 32° F. The intermittent warming also virtually eliminated visible internal injury which affected 94 percent of the potatoes held continuously at 32° F.

In addition, the scientists linked a new symptom to the "chilling injury syndrome." Halos around chilled tissue, they found, fluoresced yellow under ultraviolet light. Warming eliminated this yellow fluorescence.

The "chilling injury syndrome" starts with mahogany browning inside the potato; this turns to black heart, then to hollow heart. Hruschka has sliced open a potato which shows all three symptoms (ST–4028–4).

Potatoes held at too low a temperature react by converting their starch to sugar; this applies in a lesser degree to potatoes held at 40° F. A higher sugar content, which makes the potatoes better able to withstand low temperatures, makes them unacceptable to many buyers. Intermittent warming allows such potatoes a breather in which to change much of this sugar back into starch.

These experiments were performed on sound, bagged Katahdin and Kennebec potatoes during the 1966–67 storage season.■

Breeding Wheats for Lodging Resistance

Wheat breeders in the United States will be able to breed more efficiently for root-lodging resistance and increased yield as a result of Public Law 480 research in Israel.

Root lodging occurs when poorly anchored plants lean at an angle although the stems remain rigid. Agronomist L. P. Reitz at Beltsville, Md., ARS sponsoring scientist, says that few studies of root lodging in wheat have been made. Consequently, findings of the Hebrew University, Rehovoth, are of scientific interest in addition to their immediate practical value in breeding improved wheat.

The Israeli scientists worked with 21 common and 8 Durum varieties of both early and late wheat. They concluded that root-spreading angle is the basis for selecting wheat varieties with root-lodging resistance. Roots of the lodging-resistant varieties spread more extensively in a horizontal direction than did those of the susceptible varieties.

During this 5-year project, the Israelis also compared yield of late and early varieties with resistance to root lodging. The late varieties yielded more because of the higher number of tillers, shoots that issue from the crown.

Yield reduction due to lodging is dependent on the growth stage at which lodging occurs, the Israeli scientists found. The highest losses in yields are sustained if plants lodge at the time of heading (emergence of flowering spike) and during the early stages of grain development.

The Israeli scientists calculated that achieving effective control of lodging could increase wheat yields by as much as 40 percent.■

Planting Depth for Peonies

Garden peony tubers should not be planted deeper than 2 inches.

A study conducted by ARS horticulturist G. S. Howard at Cheyenne, Wyo., compared the effects of planting peonies at five different depths, from ground level to 8 inches. The results showed that some peony varieties will survive but not flower when planted deeper than 2 inches.

Garden peonies are hardy, perennial plants that make good cut flowers and effective borders. Howard's tests now confirm the nurseryman's rule of thumb that nonflowering in peonies is often caused by planting the tubers too deep. He recommends digging up the nonflowering peonies in the garden and planting them nearer the surface of the soil. The transplanting should be done in the fall when the tubers are dormant.

If weather conditions are favorable and the plants still do not flower in a reasonable time, diseases or insects may be the problem.

Introducing the Meadow Vole

Active, short-eared, beady-eyed little creatures are helping ARS researchers find out more about hay quality.

The new helpers are meadow voles (*Microtus pennsylvanicus*). They are slightly larger than mice, with long chestnut pelts and short tails. Their natural range is the Eastern United States, with close relatives in the West.

Voles eat mostly grass, leaves, seeds, roots, and bark of a great variety of plants—and therein lies their chief value to farm research. Whereas ruminants can live on forage alone, most simple-stomached animals have limited ability to digest grass. But voles, like horses, digest forages well because they have a tremendously enlarged caecum, or blind intestine. It constitutes about 18 percent of a vole's digestive tract and fills about half the posterior of its abdomen.

One group of scientists at Beltsville, Md., uses voles to compare the digestibility of forages for simple-stomached animals. Other ARS scientists use voles to study toxic substances in forages caused by molds.

Commercial sources of voles have not yet been established. But physiologist G. P. Lynch, who is developing the vole colony at the Beltsville laboratories, says that wild voles can be trapped and tamed quite easily. Voles reproduce rapidly. Young females start mating when about 30 days old, and can have litters at 21-day intervals, with five or six young per litter. Voles are kept in "harem" colonies, with three or four females housed with one male.

Clues to Rice Weevil Attractant

Japanese scientists are closer to identifying the ingredient in rice that attracts rice weevils, destructive pests of stored grains.

If the weevil attractant could be isolated and synthesized, it could serve as a tool to determine the extent of insect infestation and as a control when combined with a poison or chemosterilant. Besides its potential for detection and control, the attractant is intriguing to scientists because, unlike most insect attractants in foods,

Technician Valerie Patten feeds extract from hay to full-grown vole, which measures about 6 inches from nose to tail tip (ST–3932–7).

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it is neither protein nor carbohydrate.

The attractant has been difficult to isolate for study because its attractiveness to insects decreases as the compound is further divided in the purification process, indicating that a mixture of several components may be necessary for attraction.

Nevertheless, the Japanese scientists have determined that the material is acidic and highly stable, even under extreme heat and heavy ultraviolet radiation. It is also water soluble. This characteristic would make it economical and safe to apply.

The research, conducted under a Public Law 480 grant awarded by ARS, is underway at the Tokyo University of Agriculture. Entomologist L. S. Henderson, Hyattsville, Md., is the ARS sponsoring scientist for the 4-year project, which also includes research on attractants in wheat and cheese.

Hot Water Bath for Sweetpotatoes

Bathing sweetpotato sprouts in hot water helps destroy fungi that cause scurf and black rot, diseases that can severely damage sweetpotato crops.

Scurf and black rot fungi infecting a sweetpotato seed root spread onto the sprouts and eventually onto the new crop of sweetpotatoes produced by the replanted sprouts.

In the field test, ARS plant physiologist L. J. Kushman at Raleigh, N.C., and plant pathologist E. M. Hildebrand at Beltsville, Md., almost completely halted the spread of scurf to the new crop by immersing the basal portions of diseased sprouts for 10 minutes in water warmed to 120° F. before replanting.

Although the seed roots from which the sprouts were obtained contained some black rot, almost no black rot developed on the treated plants. This bath in no way injured the plants.

If hot water treatment of sprouts can be used commercially to control scurf and black rot, it may prove more effective than chemicals because heat may affect disease organisms within the tissue as well as on the surface.

Alfalfa Substitute in Forage Pellets

Dehydrated Coastal bermudagrass and citrus meal make good substitutes for dehydrated alfalfa in high-urea forage pellets for dairy cattle.

Both are less expensive than alfalfa in the Southeast, where roughly 6 million acres of Coastal bermudagrass are grown each year. Most of the Nation's processed citrus products are also produced here.

In a cooperative study by ARS and the Georgia Coastal Plain Experiment Station, Tifton, researchers pelleted rations of Coastal bermudagrass and urea, alfalfa and urea, citrus meal and urea, and citrus meal and urea with bentonite, molasses, and ammonium phosphate.

All pelleted rations, which contained 100 percent protein equivalent, were satisfactory after adjustments were made to correct high moisture and sticking. Pelleting without steam or water produced a pellet with satisfactory moisture level for storage; dusting the hot pellet with bentonite prevented caking.

Urea has been used for some time to supply part of the protein requirement for ruminants. Dairy cows, however, take in less feed when given high levels of urea in the usual mixtures.

Researchers in Ohio earlier found that pelleting urea with dehydrated alfalfa overcomes the effects of reduced feed intake enough to allow maximum milk production. They produced a concentrate for dairy cows containing about two-thirds dehydrated alfalfa and one-third urea with preservatives which provided 100 percent crude protein equivalent.

The researchers presumed that the slow release of the urea from the pellet and its nearness to the alfalfa particle increased the efficiency of nitrogen utilization. The Georgia studies now proved that dehydrated Coastal bermudagrass and citrus meal can be substituted for alfalfa with equally good results.

The experiments were conducted by ARS agricultural engineers R. E. Hellwig and J. L. Butler and by animal nutritionist M. E. McCullough, of the Georgia Station.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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